U.S. DEPARTMENT OF ENERGY
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT
OFFICE OF QUALITY ASSURANCE

AUDIT REPORT M&O-ARP-00-01

OF THE

CIVILIAN RADIOACTIVE WASTE MANAGEMENT SYSTEM
MANAGEMENT AND OPERATING CONTRACTOR

AT

LAS VEGAS, NEVADA

NOVEMBER 8–12, 1999

Prepared by: _____ Date: _____
Emily S. Jensen
Audit Team Leader
Office of Quality Assurance

Approved by: _____ Date: _____
Robert W. Clark
Director
Office of Quality Assurance

1.0 EXECUTIVE SUMMARY

This performance-based Quality Assurance (QA) Audit was conducted on the processes and activities related to the Waste Package (WP) Process Model Report (PMR) at the Civilian Radioactive Waste Management System Management and Operating Contractor (CRWMS M&O) Offices in Las Vegas, Nevada, November 8–12, 1999. The purpose of the audit was to evaluate the effectiveness of the Analysis and Model Report (AMR) process and the quality of the resultant end product, the WP PMR. The audit team evaluated the following four AMRs: Analysis of Mechanisms for Early Waste Package Process Analysis, General Corrosion and Localized Corrosion of the Waste Package Outer Barrier, Aging and Stability of Waste Package Outer Barrier Model, and Phase Stability and Aging A22 Model. The results of these AMRs will be used as input to the development of the PMR on the WP material degradation under repository conditions.

The audit team determined that the CRWMS M&O has effectively implemented critical process steps relative to the WP activities evaluated with the following exception: one deficiency was identified in the area of Software (See Section 5.0 for specific details). Based upon reviews of in-process documentation, interviews of personnel, and examination of procedure processes, the audit team determined that WP activities being conducted at the time of the audit meet Office of Civilian Radioactive Waste Management (OCRWM) QA program requirements. It should be noted that while the process activities were evaluated to the extent possible relative to the WP PMR, the supporting AMRs and PMR were in draft form, with the exception of the Mechanisms for Early WP Analysis Report.

The audit team identified one deficient condition, use of unqualified software and inadequate documentation to support verification of software macros and routines. This deficient condition served as the basis for the unsatisfactory verification of Corrective Action Request (CAR) LVMO-98-C-006. Additionally, 34 recommendations were provided to the CRWMS M&O for administrative process and technical transparency improvements. Details of the deficient conditions and recommendations are presented in Section 5.0 and 6.0, respectively.

2.0 SCOPE

The audit was conducted to evaluate the effectiveness of the AMR process for the development of the WP PMR. The audit team evaluated documented activities that constitute scientific, engineering and performance assessment analyses and models pertaining to the WP. Related AMRs were examined to determine the effectiveness of the reports in providing evidence to support the WP and to characterize WP degradation. The AMRs reviewed consisted of the analysis for determining the juvenile failure fraction of WPs, model development for Alloy 22 degradation due to general and localized corrosion, Alloy 22 degradation due to aging and phase instability under

repository conditions, and environment on the surface of the drip shield and the WP outer barrier.

The WP AMRs will support the Total System Performance Assessment (TSPA) on the subject and serve as an important reference to the License Application. The following processes and products were examined as part of this audit:

- Work Planning Summary for "Analysis and Model Reports to Support Waste Package PMR," Document Identifier (DI) TDP-EBS-MD-000003, Revision 00, dated 07/12/99

- OCRWM Work Direction and Planning Document, "Model Development for Juvenile Failures in Waste Packages," Work Package Title, "Analysis of Mechanisms for Waste Package Juvenile Failure," BBA000000-01717-0200-00070, Revision 00, dated 04/15/99

- The analysis and model process from planning through submittal of data and models to the Technical Data Management System (TDMS)

- "Analysis of Mechanisms for Early Waste Package Failure," AMR, DI ANL-EBS-MD-00023, Rev 00, dated 10/22/99

- Draft, "General Corrosion and Localized Corrosion of Waste Package Outer Barrier," AMR, DI ANL-EBS-MD-000003, Revision 00C

- Draft, "Aging and Phase Stability of Waste Package Outer Barrier," AMR, DI ANL-EBS-MD-000002, Revision 00C

- Draft, "Environment on the Surfaces of the Drip Shield and Waste Package Outer Barrier," AMR, DI ANL-EBS-MD-000001, Revision 00B

The audit team conducted personnel interviews and examined documentation in accordance with the approved audit plan to evaluate the adequacy and effectiveness of the critical process steps for the development of the AMRs that support the WP PMR.

2.1 Process Steps/Products/Documentation

The performance-based evaluation was based upon the following:

1. Satisfactory completion of the critical process steps
2. Acceptable results and quality of the deliverables
3. Documentation that substantiates quality of the products
4. Performance of trained and qualified personnel; and
5. Implementation of applicable QA program elements.

The following critical process steps were considered during the evaluation of the Work Package:

1. Planning
2. Inputs to Analysis/Models
3. Verification and qualification of data
4. Submittal of data to the TDMS
5. Use of software or models
6. Development/documentation of analysis/models
7. Validation of models
8. Checking Process
9. AMR revisions/changes
10. Approvals

2.2 The audit included a technical evaluation of the adequacy and effectiveness of the AMR/PMR process. Details of the technical evaluation are documented in Section 5.4 of this report.

3.0 AUDIT TEAM MEMBERS/OBSERVERS

Emily S. Jensen, Audit Team Leader, Office of Quality Assurance (OQA)
Kristi A. Hodges, Auditor, OQA
Victor J. Barish, Auditor, OQA
Richard E. Powe, Auditor, OQA
Robert F. Hartstern, Auditor, OQA
Frank M. Wong, Technical Specialist, Management Technical Support (MTS)
Robert L. Fish, Technical Specialist, MTS

There were five observers present during the audit:

Ken Hooks, Nuclear Regulatory Commission (NRC) Observer, White Flint, Maryland
Charles Greene, NRC Observer, White Flint, Maryland
Tom Trbovich, NRC Observer, San Antonio, Texas
Darrell Dunn, NRC Observer, San Antonio, Texas
Susan W. Zimmerman, State of Nevada, Nevada Nuclear Waste Project Office, Carson City, Nevada

4.0 AUDIT MEETINGS AND PERSONNEL CONTACTED

A pre-audit meeting was conducted at the CRWMS M&O Offices, Las Vegas, Nevada, on November 8, 1999. Daily debriefings were held to apprise the CRWMS M&O management and staff of the progress of the audit and of any potential conditions adverse to quality. A post-audit meeting was conducted at the CRWMS M&O Offices, Las Vegas, Nevada, on November 12, 1999.

Personnel contacted during the audit, including those that attended the pre-audit and post-audit meetings, are listed in Attachment 1, "Personnel Contacted During the Audit."

5.0 SUMMARY OF AUDIT RESULTS

5.1 Program Effectiveness

The audit team concluded that critical process steps applicable to the AMR/PMR process were effectively implemented; however, one deficient condition was identified with the control of software. Details of this deficient condition adverse to quality are presented in Section 5.5 of this report. Thirty-four recommendations are provided in Section 6.0.

During the audit, corrective action was evaluated with relation to the significant deficiencies documented in existing CARs that could impact the WP AMR/PMR process. The following is a status of the CARs as a result of the evaluation conducted during the audit:

CAR LVMO-99-C-001

Based on reviews during the WP audit, this CAR will remain open.

The assessment of procedures AP-3.10Q, Revision 1, ICN 1, "Analysis and Models," was found to be satisfactory in addressing the traceability and technical adequacy of data. There was one recommendation regarding the checking process; however, there is no adverse impact on the AMRs/PMR based on this recommendation to this point. Additional verification of implementation is required in order to adequately assess the effectiveness of the AP-3.10Q development and checking process of the AMRs/PMR. The verification will continue through the OQA Phase 3 verification activities and review of PMR audits.

CAR LVMO-98-C-002

Based upon reviews during the WP audit, this CAR will remain open.

AP-3.15Q, Revision 0, ICN 1, "Managing Technical Product Inputs," Data or Technical Information Confirmation Checklists and associated record roadmaps for the four WP AMRs audited were in various stages of completion. Two checklists/roadmaps, addressing a total of 10 Data Tracking Numbers (DTN) used as inputs to AMR ANL-EBS-MD-00023, were reviewed during the audit. Checklists for the three remaining AMRs were not available due to their preliminary status. These checklists were submitted to the WP organization by Lawrence Livermore National Laboratory on November 8, 1999, during the audit and had not been reviewed for lifting of TBVs. The checklists/ roadmaps were

detailed; however, minor errors and inconclusive entries were identified during the audit, which suggest a need for increased attention when articulating the answers to the checklist questions for each DTN. The Document Input Reference Sheets for the audited AMRs were in-process, with minor corrections/ clarifications suggested during the audit; i.e., consistency of terms used in Block 4, Input Status. Additional verification of implementation is required in order to adequately assess the effectiveness of the AP-3.15Q implementation. The verification will continue through the OQA Phase 3 verification activities and review of PMR audits.

CAR LVMO-98-C-006

Based on the results of the WP audit, this CAR will remain open.

Additional corrective actions are necessary to address deficiencies identified during the audit. Although recent changes to AP-SI.1Q, Revision 2, ICN 1, "Software Management," authorized use of unqualified software while in the process of being qualified, specific requirements found in AP-SI.1Q (Section 5.12) were not implemented for software associated with the audited AMRs. In addition, instances of inadequate documentation to support verification for software macros and routines were identified during the audit. The results of this audit are included in the unsatisfactory verification documented as part of the OQA Phase 3 verification of the CAR Management Plan.

CAR LVMO-98-C-010

Based on the results of the WP audit, this CAR will remain open.

The remaining CAR-010 corrective action; i.e., generation of "family trees," a general schematic of AMRs that are inputs to the TSPA, were found to be adequate; however, there was not sufficient implementation of AP-3.10Q in regard to model validation. Therefore, additional verification of implementation is required in order to adequately assess the effectiveness of the model process. The verification will continue through the OQA Phase 3 verification activities and review of PMR audits.

5.2 Stop Work or Immediate Corrective Actions Taken

There were no Stop Work Orders or immediate corrective actions taken as a result of the audit.

5.3 QA Program Activities

Attachment 2, "Summary Table of Audit Results," provides results for each critical process step evaluated. Details of the audit, including the objective

evidence reviewed, are documented in the audit checklist. The checklist is maintained as a QA Record.

5.4 Technical Audit Activities

The WP is a PMR (TDP-EBS-MD-000003) that summarizes 14 AMRs. From the 14 AMRs, the following four AMRs were selected for review: Analysis of Mechanisms for Early Waste Package Failure, AMR (ANL-EBS-MD-000023), General Corrosion and Localized Corrosion of Waste Package Outer Barrier, AMR (ANL-EBS-MD-000003), Aging and Phase Stability of Waste Package Outer Barrier, AMR (ANL-EBS-MD-000002), and Environment on the Surfaces of the Drip Shield and Waste Package Outer Barrier, AMR (ANL-EBS-MD-000001). These reports were in various stages of completion, and only one had been finalized. In examining the work in progress, the audit team reviewed the draft reports, laboratory scientific notebooks, pertinent records, and conducted interviews of the principal investigators and other key personnel.

The principal procedure governing the preparation of AMRs is AP-3.10Q. Draft reports were made available during the week before the audit. The audit team examined Revision 00 of the Analysis of Mechanisms for Early WP Failure and draft versions of the other three reports, and used the information in these reports, along with the checklists, to structure the nature of interviews of key personnel.

With the exception of the Analysis of Mechanisms for Early WP Failure, all AMRs were in the process of being reviewed and revised, so it was not possible to examine or assess the final products.

Planning for the development of the four AMRs evaluated was found to be adequate. The required QAP 2.0 Activity Evaluations to determine that the work was subject to DOE/RW-0333P, Revision 8, "Quality Assurance Requirements and Description" requirements were issued for both Fiscal Year (FY) 1999 and FY 2000 Work Packages.

Training and qualifications of personnel was found to be adequate. Verification was achieved through the performance of the individuals and their knowledge of the AMR development process and the review of training and qualification records.

The records of the checker reviews of each AMR were evaluated and no conditions adverse to quality were identified. Since these were initial issues of the AMRs, no impact reviews per AP-3.17Q, Revision 0, ICN 0, "Impact Review," were performed. There was both a compliance check and a technical check of each AMR. The evaluation of AMR revisions and changes were limited to the Analysis of Mechanisms for Early WP Process Model (ANL-EBS-MD-0023). Editorial corrections were made after the approval of Revision 00, and

were found to be acceptable. Recommendations have been provided in Section 6.0 to clarify checker responsibilities in AP-3.10Q.

Based on the review of the Analysis of Mechanisms for Early WP Failures, the technical content of this AMR is deemed to be sound. The methods used in these analyses are appropriate and the transparency of the analyses is well documented. The assumptions used in this analysis are well documented, and the verification of these assumptions is in progress (noted as To Be Verified (TBV) in the AMR). Recommendations have been provided in Section 6.0 to improve transparency and description of analysis methods in this AMR.

The "General Corrosion and Localized Corrosion of the WP Outer Barrier" AMR was well described, the model framework is sound and thorough, the technical approach is appropriate, and the experimental techniques are sound. Recommendations have been provided in Section 6.0 to improve the transparency of the AMR and enhance the fidelity of the general corrosion rate determination.

Based on the review of the Aging and Stability of WP Outer Barrier, the technical content of this AMR is deemed to be sound. The work is in an early development stage. The planned direction and experiments are appropriate and the transparency of the analyses is well documented. The assumptions used in this analysis are well documented, and the verifications of these assumptions are in progress (noted as TBV in the AMR). Recommendations have been provided in Section 6.0 to improve transparency and enhance the effects of material variability in this AMR.

The "Environment on the Surface of the Drip Shield and the WP Outer Barrier" AMR was reviewed in an early stage of development. The technical approach is appropriate and the experimental technique is sound. Recommendations have been provided in Section 6.0 to improve the transparency of the AMR and to enhance the description of the framework and core elements of the model.

5.5 Summary of Conditions Adverse to Quality

The audit team identified one deficiency during the audit in the area of software management. This deficiency is discussed in detail in Section 5.1. See the unsatisfactory verification for CAR LVMO-98-C-006 for details.

5.5.1 Corrective Action Request (CAR)

None

5.5.2 Deficiency Reports (DR)

None. (See the unsatisfactory verification for CAR LVMO-98-C-006 for details)

5.5.3 Deficiencies Corrected During the Audit (CDA)

None

6.0 RECOMMENDATIONS

1. AP-3.10Q should be revised to clarify software user responsibilities for initiating qualification of software that are not in configuration management, and implementing AP-SI.1Q (Section 5.12) requirements for interim use of unqualified software.

2. AP-S1.1Q should be revised to state what documentation is required, e.g., test cases and test results, to support that the software routine or macro provides correct results for a specified range of input parameters.

3. The AMRs evaluated during this audit should be revised to identify all software routines/macros used in the AMR development and to include a more detailed description and testing of these macros/routines. If the documentation that supports the description and testing of a routine or macro is not in the AMR, the location of that information should be identified/referenced in the AMR.

4. AP-3.10Q should be revised to :

   - Provide the checker checklists as a guidance to support reviews
   - Clarify that an impact review in accordance with AP-3.17Q, “Impact Reviews” is not required for AMRs that are original issues that are not superseding previously issued reports
   - Require the basis for selection of checkers to be documented
   - Clarify that the checker should verify that the data in the AMR is the same as that found in the TDMS

The following technical recommendations apply specifically to AMR: ANL-EB-MD-00023, Analysis of Mechanisms for Early WP Process Model:

5. A stronger justification should be provided for transparency of the rationale of using weld defect density and size distribution for stainless steel and the application of these characteristics to Alloy 22 (TBV on this Assumption is noted in AMR).

6. A brief description should be added for transparency of the rationale of the choice of a “descriptive event” for human event probabilities pertinent to events in the repository that are not directly listed in the handbook.

The following technical recommendations apply specifically to AMR: ANL-EBS-MD-000003, General Corrosion and Localized Corrosion of the WP Outer Barrier:

7. The AMR should be checked in detail to ensure that assertions and corrosion behavior features used directly in development of the WP Outer Barrier corrosion model are based on accepted data and/or qualified data (or TBV). The use of corroborative data in the AMR is acceptable as long as the data are being used for corroborative purposes only.

8. The AMR should be checked in detail to ensure that the technical bases for assertions are included in the text of the document and references are provided for the bases, as appropriate. This is important to ensure "transparency."

9. Text in the AMR that is not directly related to the development of the corrosion model for the WP Outer Barrier, or that is more appropriate for another AMR, should be removed from the document.

10. A discussion should be included in Section 6.6.6 (or elsewhere, as appropriate) that explains how the model would be configured to depict the conditions (e.g., water chemistry and temperature) under which the corrosion potential would equal or exceed the threshold potential to induce localized corrosion.

11. The techniques used for preparing crevice corrosion samples for general corrosion weight-loss determination and corrosion rate calculation should be either summarized or referenced in the AMR. This would enhance the transparency of the document.

12. To enhance transparency of the AMR, the summary description of the model in Section 6.8 should be more explicit in the following two areas:

    a. The humid air corrosion rates for the model.
    b. The microbiologically influenced corrosion rate enhancement for the model.

13. A section should be included in the AMR to document the approach that is anticipated for the model validation. This would, at a minimum, serve as an acknowledgement that this needs to be accomplished.

14. A discussion should be included in the AMR, per the "Work Direction and Planning Document" for this AMR, that explicitly describes the accuracy, precision, and representativeness of the primary model "modules."

15. The AMR should include an analysis to account for the silicate deposit weight contribution to the Alloy 22 corrosion rate determination. The discussion of this analysis should include the technical bases used to develop the analysis and it's application to the weight loss technique for determining the corrosion rate.

16. A sensitivity analysis should be performed and described in the AMR to address the magnitude of the contribution of general corrosion possibly occurring in the crevice region of the crevice corrosion samples, to the general corrosion rate calculations for the samples. The discussion of this analysis should include the technical bases for the analysis and it's applicability to the conclusions presented for the Alloy 22 general corrosion rate aspect of the model.

17. The AMR should include a discussion of the difficulties associated with the weight loss technique for determining the corrosion behavior of the very corrosion resistant Alloy 22. This discussion should include a commitment to developing an improved technique for determining the corrosion behavior of Alloy 22 that would be sensitive to and account for passive film behavior, other forms of base meal corrosion, as well as sample surface deposits such as the silicate deposits observed to date.

The following technical recommendations apply specifically to AMR: ANL-EBS-MD-000002, Aging and Stability of WP Outer Barrier:

18. For clarity and transparency, the AMR, "Purpose" section, should explicitly state that, the modeling in this AMR is for phase kinetics and effects on mechanical properties of WP materials.

19. In addition to the heat-to-heat variability effects on phase stability, the impact of variability in the chemical composition ranges of Alloy 22 specified within the ASTM B575 should also be addressed. (TBV on this Assumption is noted in the AMR).

The following technical recommendations apply specifically to AMR: ANL-EBS-MD-000001, Environment on the Surface of the Drip Shield and the WP Outer Barrier:

20. The AMR should be checked in detail to ensure the technical bases for assertions are included in the text of the document and references are provided for the bases, as appropriate. This is important to ensure "transparency."

21. The AMR, "Purpose" section, should be refined to ensure the reader understands that the AMR will present the development of a model(s) to predict the groundwater phase and water compositions on the drip shield and WP Outer Barrier surfaces.

22. The AMR, "Purpose" and "Assumptions" sections, should be refined to explicitly state that the water contact rate for both the drip shield and the WP Outer Barrier is currently assumed to be low enough to preclude any water compositions less than fully concentrated for the relative humidity and temperature conditions over which the model is constructed. Discussion of the technical basis for this assumption should also be included in the "Assumptions" section.

23. A discussion should be added with Assumption 1 (AMR "Assumptions" section) that describes the implications to the model for assuming that the composition of well J-13 water is representative of the water that will contact the drip shield and WP outer barrier.

24. An assumption should be added to the AMR, "Assumptions" section, that addresses the crushed tuff used in the evaporative concentrating tests and it's influence on the model predictions of the concentrating of water on the drip shield and WP Outer Barrier surfaces.

25. The measured pH values should be listed in Tables 16 and 17 for the concentrated waters presented in those tables.

26. A discussion should be included in Section 4.1.19 to explain the applicability temperatures of the water compositions in Table 16 that were measured between 101º C and 108º C.

27. The assumptions stated in the second paragraph of Section 4.1.23, Page 33, about the insignificance of the gas phase composition should be replaced with a discussion of how the CO_2 content of the atmospheric gas in the repository influences the pH of water contacting the drip shield and WP Outer Barrier.

28. The environment model in this AMR should explicitly include a description of the RH and temperature conditions under which liquid water phase formation can be expected to occur on the drip shield and WP Outer Barrier surfaces with salt compounds present on those surfaces. The technical basis for this aspect of the model should be presented also. This would enhance the technical basis which already exists in Section 6.5.1 of the AMR.

29. The thin water film thickness calculation included in Section 6.4.1 should be expanded to include the influence of relative humidity on that film thickness.

30. The aspect of the model describing thin water film formation should include pH levels expected in the water. The technical basis for the pH level(s) should be discussed also.

31. Section 6.4.3 should be deleted from the AMR. This section discusses the corrosion of candidate barrier materials in response to the relative humidity of their environment.

32. The discussion of the water solution in Section 6.8, fourth paragraph, should include an explanation of its applicability relative to the environment model. As currently written, this is not clear.

33. To enhance transparency of the AMR, a summary description of the model should be presented in Section 7 of the AMR. This description should include each important aspect of the model.

34. A section should be included in the AMR, per the "Work Direction and Planning Document" for this AMR, that explicitly describes the accuracy, precision, and representativeness of each important aspect of the model.

7.0 LIST OF ATTACHMENTS

Attachment 1: Personnel Contacted During the Audit
Attachment 2: Summary Table of Audit Results

ATTACHMENT 1

PERSONNEL CONTACTED

Name	Organization/Title	Pre-Audit Meeting	Contacted During Audit	Post-Audit Meeting
Andrews, Bob	M&O/Duke, Performance Assessment	X		X
Bailey, Jack	M&O/TRW, Regulatory & Licensing Director	X		
Belke, William	Nuclear Regulatory Commission/On-Site Representative	X		
Benton, Hugh	M&O/FCF, Waste Package Office MGR	X	X	X
Blaylock, James	OQA, QA Engineer	X		
Carlisle, Greg	M&O/TRW Configuration Management Secretariat		X	
Clark, Jim	M&O/TRW, Deputy, Operations Area General Manager	X	X	
Clark, Willis	M&O/LLNL Technical Area Lead		X	
Coatsworth, Michael	M&O/LLNL Data Coordinator	X	X	
Dana, Steve	OQA/QATSS, Lead Quality Engineer	X		X
Dials, George	M&O/TRW, President and General Manager			X
Eshleman, Michael	OQA/QATSS Senior QA Specialist		X	X
Estill, John	M&O/LLNL, Laboratory Supervisor	X	X	
Farmer, Joseph	M&O/LLNL, Senior Scientist	X	X	
French, William	M&O/FD, Product Checking Coordinator	X		
Gdowski, Gregory	M&O/LLNL Principal Investigator	X	X	
Glasser, William	OQA/QATSS, Corrective Action Lead	X		
Goluoglu, Katherine	M&O/FCF, Engineer, WP Operations		X	
Hasson, Robert	OQA/QATSS, Audit Lead	X	X	X
Hayes, Larry	M&O/TRW, Manager, Natural Environment Program Operations			X
Hill, Donald	M&O/IBEX, Regulatory Compliance Specialist			X
Hodson, William	M&O/TRW, Manager, Technical Data Management		X	
Howard, Robert	M&O/TRW, Manager, Data Qualification			X
Jones, Denny	M&O/LLNL, Technical Checker		X	
Justice, Judy	M&O/Duke, Training Supervisor		X	
Keith, Dale	M&O/TRW, Automated Technical Data Tracking Database Administrator		X	
Kohler, Martha	M&O/LLNL Laboratory Lead	X	X	

Name	Organization/Title	Pre-Audit Meeting	Contacted During Audit	Post-Audit Meeting
Koppenaal, Theodore	M&O/SAIC Technical Checker		X	
Lee, Joon	M&O/Duke, Performance Assessment Lead		X	
Lingenfelter, Allen	M&O/LLNL, Technical Area Lead	X		
Lugo, Mike	M&O/TRW, Process Model Report Lead	X		X
Massari, John	M&O/FCF, Principal Investigator		X	
McCright, Daniel	M&O/LLNL, Deputy Technical Area Leader		X	
McGrath, Michael	M&O/TRW, TBD/TBV Database Administrator		X	
Mobasheran, Amir	M&O/FCF, Waste Package Office Lead Checker	X		
Monks, Royce	M&O/LLNL, Engineering Assurance Manager	X		
Murthy, Ram	DOE/OQA, Lead	X		X
Pasupathi, Pasu	M&O/FCF, Waste Package Process Model Report Lead	X	X	X
Pelletier, John	M&O/SNL Technical Staff			X
Peters, John	M&O/MK, Manager, Engineering Services			X
Reshel, Tanya	M&O/LLNL, Administration		X	
Rosenburg, Nina	M&O/LLNL, Technical Checker		X	
Stahl, David	M&O/FCF, Manager, Waste Package Materials	X	X	
Spangler, Elaine	M&O/SAIC, Training		X	
Spence, Dick	DOE, Deputy, Assistant Manager, Office of Project Execution		X	
Stambaugh, Roberta	M&O/MK, Acting Manager, Performance Improvement and Configuration Management		X	
Stanworth, Pamela	M&O/LLNL, Training Coordinator		X	
Stockman, Christine	M&O/SNL, Waste Form Program Management Review Lead			X
Stroupe, Elwood	M&O/TRW, Manager, Repository Systems Operation	X		X
Summers, Tammy	M&O/LLNL Principal Investigator	X	X	
Thomas, Dan	M&O/FCF Principal		X	
Thompson, Kathleen	M&O/SAIC, Records Specialist		X	
Tunney, Dan	OQA/QATSS, Senior QA Specialist	X	X	X
VanDillen, Roxie	M&O/FCF, Technical Specialist	X	X	X
VanDillen, Patricia	M&O/TRW, Text Editor		X	
Warren, Charlie	LLNL On-Site OQA Representative	X	X	
Weaver, J.	M&O/SAIC, Process Model Report Production Coordinator		X	
Wemheuer, Robert	M&O/FD Office Manager			X

Name	Organization/Title	Pre-Audit Meeting	Contacted During Audit	Post-Audit Meeting
Wolverton, Ken	M&O/SAIC, QA Liaison			X
Woods, Mary	M&O/FD, Supervisor, Engineering Document Control		X	
Younker, Jean	M&O/TRW, Deputy, Technical Area General Manager	X	X	X

Legend:
FCF – Framatome Cogema Fuels
FD – Fluor Daniel
LLNL – Lawrence Livermore National Laboratory
MK – Morrison Knudsen
OQA – Office of Quality Assurance
QATSS – Quality Assurance Technical Support Services
SAIC – Science Applications International Corporation
SNL – Sandia National Laboratories

ATTACHMENT 2

SUMMARY OF TABLE OF AUDIT RESULTS

Process Steps	Details (Checklist)	Deficiencies	Recommendations	Process Effectiveness	Overall
Planning	p. 1-4			SAT	SAT
Inputs to Analysis/ Models	p. 5-20		5-8, 19-20, 22-24, 27-30	SAT	SAT
Verification and Qualification of Data	p. 21-27			SAT	SAT
Submittal of data to the TDMS	p. 28-29			SAT	SAT
Use of Software or Models	p. 30-33	LVMO-98-C-006	1-3	UNSAT	SAT
Development/ Documentation of Analysis/Models	p. 34-71		9-12, 13-18, 21, 25-26, 31-34	SAT	SAT
Validation of Models	p. 72-75		13	N/I	N/I
Checking Process	p. 76-87		4	SAT	SAT
AMR Revisions/Changes	p. 88-89			SAT	SAT
Approvals	p. 90-91			SAT	SAT
DELIVERABLES					
Early Waste Package Failures AMR	p. 5-8, 34-42		5-6	SAT	SAT
General Corrosion and Localized Corrosion of the Waste Package Outer Barrier AMR	p. 9-13, 43-54		7-19	SAT	SAT
Aging and Stability of Waste Package Outer Barrier AMR	p. 14-16, 55-63		18-19	SAT	SAT
Environment on the Surface of the Drip Shield and the Waste Package Outer Barrier AMR	p. 17-20, 64-71		20-34	SAT	SAT

Legend:
SAT – Satisfactory
UNSAT – Unsatisfactory
N/I – Not Implemented